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ABSTRACT

A variety of promising new media are considered from the perspectives of their educational effectiveness, major features, and potential for educational utilization. In Part I, three categories of new media are specifically addressed: (1) broadcasting systems--satellite broadcasting, high-definition (high resolution) television, (multiplexed) teletext, still picture television, facsimile broadcasting; (2) closed-circuit/cable systems--closed-circuit/cable television, videotext, integrated service digital neworks, video response systems; and (3) non-electronic delivery systems--videodiscs and the magnetic video camera (MAVICA). Additional media involving cable television systems are also mentioned. A discussion of microcomputers and education in Part II is based on data taken from a 1983 survey of microcomputer procurement and utilization in Japanese schools and in social education facilities such as public halls, libraries, museums, youth education centers, and audiovisual centers/libraries. Twelve examples of microcomputer uses in specific schools and social education facilities are given. (LMM)

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# EDUCATIONAL USE OF NEW MEDIA IN JAPAN

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## Introduction

This paper is an attempt, from among the new media which are continually being developed as a result of the remarkable progress now going on in electronics, to take up those which are worthy of attention from a standpoint of educational effectiveness, and to try to introduce their major features as well as outline their potentials for educational utilization.

We wish to express our deep appreciation to Mr. Shozo Usami of the NHK (Japan Broadcasting Corporation) Radio and Television Culture Research Institute and to the Audiovisual Education Section, Ministry of Education, for their cooperation in furnishing the materials which made preparation of this report possible.

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# Part I

## Educational Utilization of the New Media in Japan

### What are the "New Media"?

A phrase frequently heard among those involved in communications and media in Japan today is the term "new media." Basically, it refers to a number of new video systems which have been recently developed and is equivalent to the term "new technologies" as used by media specialists in English-speaking countries.

The next question is exactly what are these new video systems? In the past, the Japanese concept of television has been one of a series of earth stations linked together by microwave networks and beaming VHF of UHF signals to the surrounding homes and schools. The new media in Japan may be categorized under the following: (A) broadcasting systems, (B) closed-circuit/cable systems, and (C) non-electronic delivery systems. Each of these may be sub-divided even further, to wit:

**(A) Broadcasting Systems**

1. Direct Broadcast Satellite — the sending of TV signals directly from satellites to homes, schools and businesses.
2. High definition, high-resolution TV
3. Teletext
4. Still picture TV
5. Facsimile

**(B) Closed-circuit/Cable Systems**

6. Cable Television (Japanese example, Hi-OVIS)
7. Videotext (Japanese example, CAPTAIN)

8. Integrated Service Digital Network (in Japanese, INS or Information Network System)
9. Video Response System

**(C) Non-electronic Delivery Systems**

10. Videodiscs
11. Mavica (Magnetic Video Camera)

Only representative items for each of the above will be discussed in this paper.

One should realize that in Japan the "new media" are a mixture of technologies of varying dimensions. Look at only the first category, "broadcasting systems." It includes changes in the means of transmission, changes in the quality (resolution) of the images being transmitted, and changes in technologies for displaying that information (character generators, etc.). It is possible, theoretically, to envision transmission of high definition still picture broadcast via satellite.

In the same way, many combinations are possible for closed-circuit/cable systems. Classifying the new media into the above categories is little more than placing the emphasis upon one or another of the construct elements involved and thereby arrive at some kind of synthesis. Furthermore, recent trends are towards the establishment of comprehensive "super" broadcasting stations and electronic mail systems combining elements from all of the major categories outlined above. The former, "super" stations, involve the tying together of closed-circuit or cable networks with satellite transmission. Electronic mail systems are delivery networks which include either cable or open transmission or combinations of both at one or more points in the overall distribution network. Reflecting on this shows that the above categories are little more than just one way of dividing the "new media" as advocated today, and are definitely not based upon any kind of "a priori" theory of classification.

When, exactly, did the public become aware of the new media? The beginnings were in 1967 when the Columbia Broadcasting System, in the

United States, announced the development of electronic video recorders (EVR) and in 1969 when the Sony Corporation, in Japan, announced its new videocassette recorder (VCR). Neither of these, however, were much more than audiovisual devices which used TV receivers as means for displaying television as it already existed. They did, however, incorporate one significant feature important to nearly all types of recording devices. They could be used to repeat any scene desired any number of times. Until then, this has been the exclusive province of film, particularly of the 8mm film loop projector.

EVR, however, is seldom mentioned today, primarily due to the fact that its commercialization and diffusion were slower than that of VCR, and production was terminated within a few short years. On the other hand, the development and diffusion of the videocassette recorder has continued until in Japan today, 20% of the homes, 73% of the elementary schools, 89% of the lower secondary schools and 96% of the upper secondary schools are equipped with one or more such recorders. Setting aside the problem of how extensively it is used, it has been more than ten years since the videocassette recorder was first put on the market and it can no longer really be considered a "new media," at least not as far as the schools are concerned. At the same time, it is important that the VCR be given ample consideration whenever future educational use of the new media is being discussed.

## The New Media Today

The following is an outline of the situation vis-a-vis the new media at the time this report was written (the summer of 1983) and points out those which are still in the experimental stage, those which are already practical realities, and how important each of them may be to education.

## A. Broadcasting Systems

### 1. Satellite Broadcasting

Japan's first experimental broadcasting satellite, "Yu," was launched by the American National Aeronautics and Space Administration in 1978. It was used in a number of experiments. The first practical broadcasting satellite, "BS-2a," will be launched in February 1984. This satellite, having just two channels, will be used by NHK to provide new or improved service to those areas where earth station reception is difficult. It will be used for experimental satellite transmissions also. That is to say, while, the educational TV programs currently being broadcast by NHK will be transmitted by this satellite directly into the homes, the proportion of educational programming will be somewhat less than what is broadcast from the earth stations and the difference will be used for experimental programming. Rather than using the VHF and UHF wave bands now occupied by the earth staions, BS-2a will use superhigh frequency (SHF) channels in the 20 gigahertz band.

BS-3, with four channels, is scheduled for launch in 1989. This will use half of the total of eight channels allotted to Japan for satellite broadcasting.

These satellite broadcasts will be transmitted directly into the homes via a parabola antenna, approximately one meter in diameter, and will deliver quality audio and video reception. BS-2a is the first satellite in the world designed to provide such direct, individual home reception.

It is anticipated that BS-2a will also be used in experiments involving high definition TV, teletext and still picture broadcasts. Progress in developing means for practical application of these new media should be greatly enhanced as a result of these experiments.

## 2. High-definition (High Resolution) Television

NHK began development of a system of high definition TV in the mid-1960's, and announced the results at a meeting of the Society of Motion Picture and Television Engineers (SMPTE) in San Francisco in 1981. It was one of the more important topics covered at that meeting.

Present-day TV in Japan and the United States uses 525 horizontal scanning lines. High definition TV has over twice that number, a total of 1,125. This permits an extremely clear and definitive video picture. For example, with ordinary TV it is not possible when panning the stands at, let's say, a baseball game to see each individual face distinctly. But with high definition TV you can not only tell who is and who is not wearing glasses you can also tell if they have sideburns or not.

High definition TV requires a band width equal to several ordinary TV channels combined. It can be compared to trying to drive a car down a narrow country lane meant only for bicycles. Unfortunately, Japan's current earth station channel allotment plan does not permit the broadcasting of high definition TV. The use of satellite broadcasting and SHF channels, however, would create greater freedom for channel allocations and thereby also permit the incorporation of high definition TV broadcasting. Furthermore, as electronic technology continues to advance, it may well become possible to develop means it compress high definition TV into a relatively narrower band.

Educational applications of high definition TV are still rather experimental. The first thing that comes to mind, however, is that high definition TV permits display of many more letters or characters per screen. Using the English alphabet present-day TV in the classroom can show only about 25 letters per line and only four lines per screen. This means only about 100 still rather difficult to read letters can be displayed at a time. But with high definition TV, over four times that number per screen, from four to five hundred letters can still be easily read.

Using present-day TV, it is not possible to broadcast detailed maps

and graphs directly from the textbooks just as they are. They must first be "deformed" by rearranging and redrawing before they can be used on TV.

In other words, present-day TV can show detailed information only in close-up. With high definition TV it is also possible to show how the close-up relates to the overall picture. This permits showing relationships, something which is very effective when producing programs for very young children. Showing part to whole relationships is also important in science and social study classes at the elementary school level, particularly for those children who often have trouble keeping up with the rest of the class. Further, it will make it easier for children to keep pace with the tempo of ordinary TV programs and make those parts where the content is difficult to follow more easily understood and thereby increase their educational value.

A great deal is also anticipated through combining high definition TV with teletext and still picture transmission. Using high definition TV in CAI-type instruction it is possible to display the instructions on how to answer the questions (i. e., Yes = 1; No = 2) alongside the questions themselves. With present-day TV, it is not possible to display informational and instructional content at the same time because doing so makes it very difficult to read.

Because high definition TV picture quality is extremely good, it can bring a new forcefulness to art and history programs, and, in the minds of the viewers, develop feelings of actually being present. It is anticipated that for these reasons, among others, and as a result of its outstanding educational characteristics, high definition TV will bring about a revolution in future educational program production techniques.

### 3. (Multiplexed) Teletext

Multiplex television broadcasting of text and graphic information is frequently referred to as teletext broadcasting.

NHK will start experimental teletext services in Tokyo and Osaka in October 1983. At first, this service will be only for the deaf. Educationally, these broadcasts will be limited to helping such people learn of current problems and increase the pool of information they need for daily life. But the educational possibilities of teletext broadcasting include, for example, broadcasting foreign films and dramas in the original language with superimposed Japanese translations on the multiplex channel. The viewers could "challenge" their abilities to understand the original language by turning off the teletext channel. Then, whenever they did not fully understand the program, they could turn the Japanese translation on again. After "catching up" with the story they could again turn the teletext channel off and continue to "challenge" their abilities. This, in a sense, permits viewers to learn at their own pace.

At present, however, it is difficult to estimate how quickly receivers capable of receiving multiplexed teletext may be diffused, therefore attempting the above too soon could result in taking away the right of those who do not understand any foreign languages at all to enjoy TV movies and dramas in their own tongue.

Compared to England, which started regular broadcasting of multiplexed teletext in 1976, Japan seems to be making little progress. Problems, however, include the fact that the Japanese-Chinese characters and Japanese syllabaries in daily use in Japan today involve over 2,000 symbols, while the English speaking countries need, including both capital and lower-case letters, less than 100 symbols in total. This greatly increased degree of complexity in the writing system means that the technology must be fully reliable and transmission methods inexpensive. Developing these has been the main reason progress is taking so much time.

However, once it becomes possible to accurately and inexpensively transmit Japanese-Chinese characters, not only will Japan but Korea and China and even the Arabic countries will be able to reap the benefits of

applying this system to instruction in reading and writing.

## 4. Still Picture Television

It is possible, using a single TV channel to simultaneously broadcast 50 or so color still picture (stills, slides, graphics, texts, etc.) sound programs. (As announced in a 1967 magazine article by Dr. Etsuro Miyamoto, then Director of the NHK Technical Research Laboratories.)

Unlike (multiplexed) teletext, however, this system does not permit simultaneous broadcasting of ordinary television programs. Since still picture TV does not include movement, it is not as attractive as an entertainment medium, but from an educational standpoint it has an advantage in that still pictures are usually easier to remember than moving ones. Still picture TV's ability to simultaneously broadcast a multitude of programs also has the following advantages:

a) It continuously provides the viewers with a wide choice of programs.

b) Integrating a number of still picture TV programs into a single unit aimed at a common educational objective would make it possible to transmit CAI programs which could measure viewer responses and incorporate giving its audience a knowledge of the results.

Laboratory experiments on still picture TV technology reached a peak in the 1970's and experimental satellite transmission has already been proven successful. However because Japan currently has no surplus TV channels it appears that the prospects for still picture TV being put to practical use are rather poor and it may therefore continue to "sit on the bench" for a number of years. But, if in the future, a multiple-channel CATV system is established or if satellite broadcasting becomes a reality, it might become possible for still picture TV to "come out into the playing field."

Experiments similar in nature to still picture TV have been conducted.

Examples include the use of slow-scan TV by the Tokyo Institute of Technology to transmit still picture TV programs over ordinary telephone lines and the use of a microfilm memory system by the Tama New Town Coaxial Cable Information System (CCIS) to transmit silent still picture TV programs. It should be noted, however, that the technology behind these experiments is quite different from that of the still picture TV discussed in this section and that picture quality is also drastically inferior.

## 5. Facsimile Broadcasting

Placing a printing device alongside the TV receiver permits the printing of texts, books and newspapers at the touch of a button. This technology is already being extensively used between newspaper offices; other practical applications include the printing of Tokyo newspapers in far-away Hokkaido or transmitting weather maps to ships at sea.

General household utilization, however, is still at the experimental level. And, compared to the other yet-to-be-realized new media, it would probably involve fairly major capital outlays plus high operating costs for such a system to begin to actually furnish texts and newspapers to the public. Besides, a reliable postal system, growing commercial package carrier services and the established newspaper and magazine distribution systems already fill Japan's needs for rapid and trustworthy delivery of printed materials.

Facsimile devices which print braille have already been developed in the laboratory. These would be very useful in correspondence education for the blind.

In general, effective uses of facsimile include transmissions between individuals or the establishment of an on-campus transmitter for providing information to students enrolled in various courses. This later would most likely require only a rather small broadcasting system. Unlike in the United States and elsewhere, where they have already been

established in many areas, Japan has had little experience with such small broadcasting systems. Japan, however, thanks to the existence of NHK, does have a great wealth of experience in the operation of nation-wide educational broadcasting systems. It is difficult to forecast what may happen in regards to such small systems in the future but, at the moment, chances for their development appear to be rather slim.

## B. Closed-circuit/Cable Systems

### 6. Closed-circuit/Cable TV

Closed-circuit/cable TV can be sub-divided into two major types:

a) Video camera-equipped systems.

b) Keypad-equipped systems.

In Japan, the former is represented by Hi-OVIS (Highly Interactive Optical Visual Information System) located in Higashi Ikoma, just east of Osaka. Where, until now, homes have been equipped with TV receivers only, each subscriber in the Hi-OVIS system has also been furnished a video camera and microphone. This experimental project, sponsored by the Ministry of International Trade and Industry, uses an optical fiber cable network to connect 158 households. It started in 1978 and is still in operation today. In addition to the traditional CATV role of rebroadcasting ordinary television programming, services provided include locally-produced programs and, upon user request, transmission of moving and still pictures, and teletext information.

The video cameras in the homes are effective in the production of local programs. For example, in English instruction, it is possible to increase all of the viewers' feelings of participation by having one of them play the role of the student and during the course of the program actually show him or her at home. Also, during oil painting lessons, etc., it is possible to show everyone what other students have accomplished. Increasing the amount of visual information also increases the ef-

fectiveness of the programs. However, this technique also requires that the viewers insure that lighting is sufficient, the camera is focused, etc. Due to the fact that the cameras are located in the living rooms, there are also problems of invasion of privacy.

In actuality, however, even for the relatively positive participants in the Hi-OVIS project, only 60% of them have used the two-way interactive system more than twice. The most common reason for not participating given by those who have not participated at all has been "I haven't been home at the right times." (60%) The second most common reason has been "I am too bashful." (over 50%) The third reason given has been "It bothers me that others can see my hair or clothes, or the condition of my home." (27%) The most common reason for participating given by those who have participated has been "Because I was asked by the Hi-OVIS station," (80%) while the second most common reason has been "I participated because I wanted to." (40%) These responses show that participation has not really been positive. One cause for this could be that, because the project is still experimental, the families have yet to develop any real habits of participation.

At the same time, if everyone did suddenly become an active participant, Hi-OVIS would suffer rather severe overflow problems. Hi-OVIS has only a small number of subscribers, but such a system with just a few thousand active participants, would soon discover that many viewers (students) who did sit down in front of the camera would do so with the thought that "I doubt if I will be called on today either."

In keypad-equipped systems, viewers use a 10 or more key keypad, similar to a pocket calculator, as a means of making requests of the TV station or in replying to questions, etc. The CCIS (Coaxial Cable Information System) project in Tama New Town west of Tokyo and under the direction of the Ministry of Postal Services is representative of what Japan has attempted to do in this area. Operated on an experimental basis from 1976 through 1980, it proved impossible to establish on a successful commercial basis.

Although, in addition to rebroadcasting of regular TV programs, this project offered program information, flash news, local news, shopping information, a home printer service and a requestable still picture program service as well as other experimental features, the keypads were used almost exclusively for requesting specific information and seldom used to respond to questions, etc. This may have been due to the fact that there were only 500 participating households. Also, the scale of the experiment, the national characteristics of those involved, and the motives behind the development of the system are all quite different from QUBE and similar systems developed in other countries.

In education, one advantage of two-way interactive cable is that there are no worries about "starting midway through the program." It is possible to watch whatever one desires whenever one desires to do so "right from the beginning." This can not be done with normal broadcasting, of course.

Although actually sent over the airwaves in one direction only, multiplexed still picture TV and teletext also make selection from a number of programs possible and, in many ways, may be thought of as "imitating" the characteristics of two-way interactive TV.

## 7. Videotext

The CAPTAIN system, (the acronym being taken from the first letters of its somewhat "Japanese English" name: "Character and Pattern Telephone Access Information Network System"), was initiated by the Japan Ministry of Postal Services and the Nippon Telegraph and Telephone Corporation in December 1969. The home TV receivers and a central computer are linked via ordinary telephone lines making it possible to use a keypad for selection of desired information. Such systems are known internationally as "videotext." Examples include PRESTEL in England (already operating on a commercial basis) and TELETEL in France (still experimental).

It is anticipated that the CAPTAIN system will go commercial sometime during 1984. Currently, 679 programs for pre-schoolers, elementary, and lower secondary school children are being broadcast. The April 1983 issue of *Audiovisual Education* carried an article describing how the Omori First Elementary School, located in Ota Ward, Tokyo, has experimented with using two of these programs as part of its curriculum: "Stars" (for science classes) and "Japanese-Chinese Characters" (for Japanese language classes).

## 8. Integrated Service Digital Networks

In Japan, these are called "INS" or "Information Network Systems." While at first glance this concept may appear somewhat abstract, these networks offer telegraph, telephone, data transmission, telex, and facsimile services within a single digital transmission network.

The Nippon Telegraph and Telephone Corporation is assuming that these networks will be available from 1995 and will become the electronic communications systems of the 21st century. Plans are being made to initiate an experimental pilot system in Mitaka, a western suburb of Tokyo, during 1984.

When fully developed, this system will use optical fiber cable and satellite transmission to tie homes, work places, banks, local governmental agencies, etc. together and will incorporate TV phones, facsimile and the CAPTAIN system into a single service. Home offices and distant video retrieval will become possible. However, there are already articles warning that when this comes about, just as the Nippon Telegraph and Telephone Corporation now has a common carrier monopoly for the telephone, it or another organization may develop to the point where it will have sole control across the entire information transmission spectrum. Although there are plans for converting the Nippon Telegraph and Telephone Corporation into a non-public organization, at the moment every indication is that reorganization of the video image division is to be

one of the very last steps undertaken. Furthermore, the system currently envisioned is for business use only and no positive plans have been prepared for educational use of any kind. However, if some person or organization which would present educational programming were to appear, most likely such programming would be transmitted. The system itself is still in a stage of conceptualization and methods for insuring a commercial return, etc., are still to be decided.

## 9. Video Response Systems

Starting in 1977, the Nippon Telegraph and Telephone Corporation began experimenting with the use of a 4.5 megahertz, wide band cable system to transmit text and figures at the user's request. The sound and video for this system are of standard TV quality. Some of the programming on this system would be transmitted on a continuous basis much like time signals and weather information are given as part of modern day telephone information services. These would permit the user access at any point during the transmission.

There are two basic types of video response systems: home use, and business and educational use. To an extent, applying this system to CAI is also possible and experiments along these lines are currently being conducted in Tokyo.

There are many questions remaining regarding video response systems, which might well be called telephone line editions of CATV or TV editions of INS, and much depends upon how close a match is maintained between the rate of technology development and the rate of general system diffusion, as well as how problems related to the expense incurred in handling required equipment replacement, etc., are resolved. Still, small scale partial application of such systems have already been realized in museums and other locations.

## C. Non-electronic Delivery Systems

### 10. Videodiscs

Laser videodiscs first appeared in 1981; video high density (VHD) videodiscs in 1983. Japan is now also finally raising the curtain to the videodisc age. While there are already English language and mathematics instructional materials on the market, most programs are aimed at helped adults improve various skills, programs such as "How to Improve Your Golf," etc. The schools are paying a great deal of attention to videodisc technology, but hasty action could result in software problems and other difficulties arising from model changes, etc. For these reasons, educators are being careful to not squander their money.

Videodiscs permit both single track replay and random access. Other advantages are that high quality sound and video are possible, however since erasing and rerecording are not possible at present, it is anticipated that videotape recorders will maintain their position of supremacy in Japanese school education for some time to come. Having said that, however, videodiscs are still worthy of attention as one of the new media.

### 11. Magnetic Video Camera (Mavica)

Mavica, or the magnetic video camera, was announced by the Sony Corporation in 1981. It could be called a still camera version of the videotape recorder. Pictures can be displayed on ordinary TV receivers as well as transmitted by telephone lines. Prints are also possible. The magnetic disc, the equivalent of film in an ordinary camera, can be erased and reused any number of times.

While some educators see it as readily adaptable to media instruction at the elementary school level, in Japan the number of schools which have become familiar with this new medium is still extremely small and

only a very few schools are now using it, even on an experimental basis. How thoroughly the Mavica system will come to be diffused in the future is still very problematical.

## Postscript — Other Media

A footnote for readers from the United States and other countries where CATV sytems are well developed may be in order. The first community antenna or CATV system in Japan was completed in Ikaho Hot Springs, Gumma Prefecture, in 1954 in order to provide better TV reception to the community. While there have been some exceptions, nearly every CATV system put up since then has been equipped only to provide better TV service to remote mountain areas or to residential areas in the shadow of tall buildings, etc.

While the average number of homes connected to any one CATV system remains rather small, collectively the number of such households is now fairly large. Throughout Japan, as of 1982 there were 33,981 CATV facilities with a total of 3,655,755 subscribers, but only 384 of these systems had over 500 subscribers.

Except for experimental projects, two-way interactive CATV is prohibited in Japan and there are only 50 CATV systems throughout the country which go beyond simple retransmission of regular TV programs and systematically produce any programs of their own.

By adding such technologies as teletext and videodiscs, which are just beginning to be available in other countries, to those technologies which already exist in Japan, such as the relatively well diffused videotape recorder and the still-to-be-diffused true CATV, in the final analysis one could say, in regards to the new media in Japan today, that they shall all come to play their own unique role as a result of the influence each of them will have upon the others.

# Part II

## Microcomputers and Education

### 1. Introduction

From a practical educational point of view, microcomputers probably have the greatest potential of any of the various new media being developed as a result of the continuing progress being made in electronics today. In the business world also, in recent years microcomputers have increased more rapidly than have main frame computers. They have become basic to our ever-developing information society, and it is certain that they will also have a great deal of influence over educational content and methods in the future.

In Japan, the educational use of computers started at the university level. The use of computers in processing of scientific data and in educational administration started simultaneously with the introduction of main frame models into the universities. They also began to be used in applied instructional research beginning in the early 1960's. Centers for Educational Technology were established one after another in a number of national teacher training institutions during the 1970's and many of these immediately embarked upon research on the use of computers in education. With the advent of the 1980's, microcomputers began to diffuse rapidly throughout all levels of society, giving further impetus to a broad range of educational research activities.

At the upper secondary school level, computers are used primarily in technical and commercial courses for vocational training. The technical curriculum includes a course on "Information Science" while the commercial curriculum includes a course on "Information

Processing." Both courses offer instruction in various computer skills. A mathematics course, available to students studying under the general academic curriculum, also includes a section on computers. Very recently, some lower secondary school and elementary schools have also purchased microcomputers and are using them both in instruction and for extracurricular club activities. These trends will most likely continue to develop for some time to come.

As far as social education facilities are concerned, libraries were relatively quick at purchasing computers but other facilities have only recently also begun to procure microcomputers. These later are being used for information retrieval as well as for public seminars on microcomputer skills.

## 2. Microcomputers in Japanese Schools

In order to determine the actual situation regarding procurement and utilization of microcomputers in the schools, the Audiovisual Education Division, Ministry of Education, Science and Culture, with the cooperation of the various prefectural boards of education, conducted a survey as of January 1, 1983. The data in this section is taken from the results of that survey.

### (1) Elementary and Lower Secondary School Facilities

The diffusion rate and average number of computers per school at the elementary and lower secondary school levels are shown in Table One. The diffusion rate for public elementary schools is only 0.1%, in private schools it is still just 5.4% and overall it is again a mere 0.1%. In other words, only about one of every 1,000 elementary schools in Japan had even one microcomputer as of the date of this survey. The situation is somewhat better at the lower secondary school level, the diffusion rate being 0.9% for public schools, 18.2% for private schools and 1.8% overall. This means that about one out of every 50

lower secondary schools in Japan now has a microcomputer. However, the rate for private lower secondary schools may be artificially high due to the fact that many of them are on the same campus and share computer and other facilities with an upper secondary school section. In public schools, also, there is some shared utilization reulting from local boards of education having purchased microcomputers for that purpose.

**TABLE ONE**
**Microcomputers in Elementary and Lower Secondary Schools**

| | | Number of Schools with Microcomputers | Total Number of Schools | Diffusion Rate | Average No. per School for Schools with Microcomputers |
|---|---|---|---|---|---|
| Elementary Schools | Public | 27 | 24,802 | 0.1% | 1.1 |
| | Private | 9 | 168 | 5.4% | 2.4 |
| | Overall | 36 | 24,970 | 0.1% | 1.4 |
| Lower Secondary Schools | Public | 94 | 10,252 | 0.9% | 1.3 |
| | Private | 100 | 550 | 18.2% | 3.1 |
| | Overall | 194 | 10,802 | 1.8% | 2.2 |

Note: Total number of schools is as of May 1, 1982.

(2) Upper Secondary School Facilities

A total of 2,370 Japanese upper secondary schools had microcomputers as of the date of this survey. Of these, 1,970 were public and the other 400 are private. The public upper secondary school diffusion rate was 49.8%, while the private schools rate was only 32.3%. The average is 45.6%. In other words, approximately one out of every two upper secondary schools had at least one microcomputer. Some had many more. Although it accounts for only about 94% of the upper

## TABLE TWO
### Microcomputers in Upper Secondary Schools

| Number of Micro-computers | Public Schools | | Private Schools | | Total | |
|---|---|---|---|---|---|---|
| | Number of Schools | Ratio | Number of Schools | Ratio | Number of Schools | Ratio |
| 1 | 744 | 40.4% | 186 | 47.7% | 930 | 41.7% |
| 2 | 300 | 16.3% | 53 | 13.6% | 353 | 15.8% |
| 3 | 217 | 11.8% | 25 | 6.4% | 242 | 10.8% |
| 4—5 | 193 | 10.5% | 34 | 8.7% | 227 | 10.2% |
| 6—7 | 138 | 7.5% | 17 | 4.4% | 155 | 6.9% |
| 8—10 | 110 | 6.0% | 21 | 5.4% | 131 | 5.9% |
| 11—20 | 98 | 5.3% | 33 | 8.5% | 131 | 5.9% |
| over 21 | 41 | 2.2% | 21 | 5.4% | 62 | 2.8% |
| Total | 1,841 | 100.0% | 390 | 100.0% | 2,231 | 100.0% |
| Average Number per School | 3.9 | | 4.8 | | 4.1 | |

secondary schools which had microcomputers, Table Two shows possession by number of microcomputer systems per school. It also shows that nearly 70% of the scholls included in these figures had three or less microcomputers, the average for public schools being 3.9, for private schools 4.8 and overall only 4.1 systems per school. Table Three is a breakdown by courses offered for those upper secondary schools which had 21 or more microcomputers. It shows that the majority of these schools were either technical or vocational schools.

## TABLE THREE
## Courses Offered by Upper Secondary Schools with 21 or More Microcomputers

| | Public Schools | Private Schools | Total |
|---|---|---|---|
| | — Single Course Schools - | | |
| General Course | 1 | 4 | 5 |
| Technical Course | 35 | 2 | 37 |
| Commercial Course | 1 | 1 | 2 |
| | — Multiple Course Schools - | | |
| Gen/Tech Course | 1 | 4 | 5 |
| Gen/Comm Course | 1 | 7 | 8 |
| Tech/Comm Course | 2 | 0 | 2 |
| Gen/Tech/Comm Course | 0 | 2 | 2 |
| Gen/Math Course | 0 | 1 | 1 |
| Total | 41 | 21 | 62 |

(3) Utilization of Computers in the Schools

Table Four outlines the various ways that Japanese schools are using microcomputers.

Computer-assisted instruction, or CAI, includes the use of microcomputers in instruction or in helping the students with their studies; computer-managed instruction, or CMI, refers to computer use in school management and processing educational data. Computer education, above, includes teaching about computers in general and refers to the instruction given in the "Mathematic" course in the upper secondary school or similar basic computer education. The data being quoted in this report does not include information about such

## TABLE FOUR
## School Utilization of Microcomputers

( ) = %

| Type of Use | CAI Application | CMI Application | Computer Education | Club Activities | Number of Schools |
|---|---|---|---|---|---|
| | | — Elementary Schools - | | | |
| Public | 23 (85.2) | 6 (22.2) | 0 (0.0) | 15 (55.6) | 27 |
| Private | 2 (22.2) | 8 (88.9) | 0 (0.0) | 2 (22.2) | 9 |
| Total | 25 (69.4) | 14 (38.9) | 0 (0.0) | 17 (47.2) | 36 |
| | | — Lower Secondary Schools — | | | |
| Public | 31 (33.0) | 60 (63.8) | 2 (2.1) | 32 (34.0) | 94 |
| Private | 18 (18.0) | 76 (76.0) | 2 (2.0) | 31 (31.0) | 100 |
| Total | 49 (25.3) | 136 (70.1) | 4 (2.1) | 63 (32.5) | 194 |
| | | — Upper Secondary Schools — | | | |
| Public | 688 (34.9) | 1,209 (61.4) | 318 (16.1) | 766 (38.9) | 1,970 |
| Private | 131 (32.8) | 294 (73.5) | 59 (14.8) | 111 (27.8) | 400 |
| Total | 819 (34.6) | 1,503 (63.4) | 377 (15.9) | 877 (37.0) | 2,370 |

professional courses as "Data Processing" or "Information Science" which are part of the vocational curricula at the upper secondary school level.

Overall, CMI applications predominate. These are followed by CAI applications and extracurricular club activities. However, at the elementary school level CAI usage seems to be more popular. Comparing the figures on CAI application with the information on possession in Tables One and Two indicates that in many instances instructional use equals only simple presentation of instructional materials. Further, most CMI applications involve little more than processing and administration of grades and student health data.

### 3. Microcomputers and Social Education Facilities

**TABLE FIVE**
**Microcomputers in Social Education Facilities**

| | Number of Facilities with Microcomputers (Total number of units) | Total Number of Facilities | Diffusion Rate |
|---|---|---|---|
| Public Halls | 8 (49) | 17,195 | 0.05% |
| Libraries | 49 (59) | 1,402 | 3.5% |
| Museums | 3 (43) | 269 | 1.1% |
| Youth Education Centers | 3 (12) | 940 | 0.3% |
| Audiovisual Centers/Libraries | 9 (36) | 771 | 1.2% |

NOTE: Total number of facilities is as of May 1, 1981.

Table Five is an outline of the situation regarding microcomputers and social education facilities. Looking at diffusion rates, libraries are highest at 3.5%, audiovisual centers/libraries second at 1.2%, and museums third at 1.1%. Although these are all rather low, the number of microcomputers per institution which is so equipped, on the whole, is higher than it is in the schools.

It is felt, however, that many libraries, particularly central libraries in the larger cities, may have either large main frame computers only or in addition to the microcomputers included in the above table. Taking these institutions plus those which may have only terminals into account, means that the diffusion rate is much higher than Table Five may indicate. Furthermore, regarding some of the other types of facilities listed in this table, oftentimes microcomputers are leased for a specified short

period of time in order to conduct workshops or seminars on computer programming and utilization. These, also, are not included in the figures given in Table Five.

An outline of how social education facilities are using microcomputers is given in Table Six. Generally speaking, CMI applications appear to be

**TABLE SIX**
**Utilization of Microcomputers in Social Education Facilities**

| | CAI Applications | CMI Applications | Computer Education | Number of Facilities |
|---|---|---|---|---|
| Public Halls | 0 (0.0%) | 2 (25.0%) | 7 (87.5%) | 8 |
| Libraries | 0 (0.0%) | 49 (100.0%) | 0 (0.0%) | 49 |
| Museums | 1 (33.3%) | 3 (100.0%) | 0 (0.0%) | 3 |
| Youth Education Centers | 1 (33.3%) | 1 (33.3%) | 2 (66.7%) | 3 |
| Audiovisual Centers/Libraries | 1 (11.1%) | 7 (77.8%) | 3 (33.3%) | 9 |

the most common. In libraries and audiovisual centers/libraries, this includes keeping track of book, instructional film, and other educational material loans, and information retrieval, statistical data processing and so on. The second most common means of using microcomputers seems to be for computer education. Also, many public halls and audiovisual centers/libraries offer public workshops and seminars on microcomputer utilization and programming.

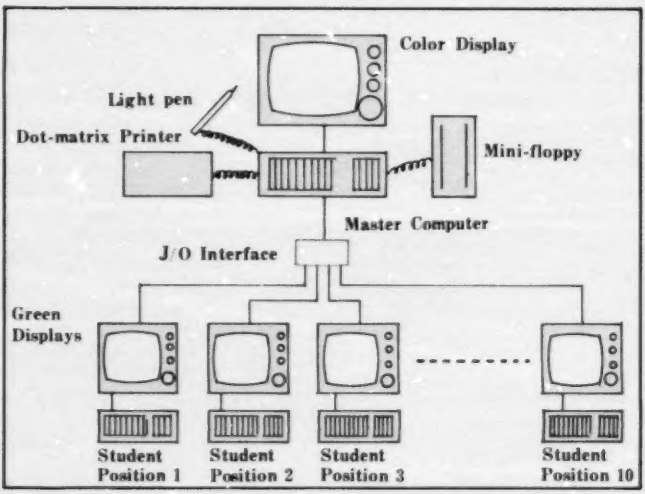
## 4. Some Examples of Microcomputer Utilization

The following are examples outlining how schools and social education facilities are using microcomputers in education.

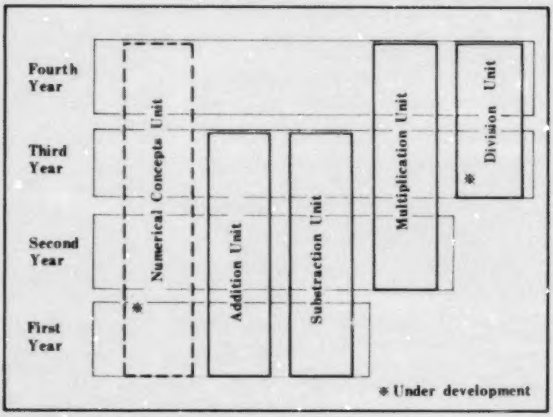
(1) Musashino Municipal Inokashira Elementary School (Tokyo)

This elementary school is using ten microcomputers in instruction in arithmetic. To this end, the teachers used BASIC to develop their own software using BASIC. Figures One and Two outline the hard and software systems developed at this school.

**FIGURE ONE**
**Inokashira Elementary School — Hardware**



## FIGURE TWO
## Inokashira Elementary School — Software




For each class, the teacher first asks the students to review the previous day's lessons. He or she then passes out a sheet of new materials and drill problems. The students work with these at their own pace. When they finish this work they go to the "answer corner" where the correct answers are posted to check their work. If they find they made a number of errors or if they feel unsure about any of the material they can go to the teacher for help. However, if they did well and feel prepared, the students can go to another area to use a microcomputer to practice new material and drills. The drills are divided into three levels of difficulty and are designed to orderly lead the students from the easiest to the most difficult. Again, the students are abie to call upon the teacher whenever they need assistance. It is anticipated that students who finish this portion of their studies will then become tutors to the others and, in this

way, assist the teacher. The results of student microcomputer use is retained as data for later individual guidance by the teacher. All the students seem to enjoy this system very much and upper level students have even begun to prepare simple computer programs for their lower grade classmates.

(2) Sakura Municipal Takezono Higashi Elementary School (Ibaragi Prefecture)

The CAI system at this school was developed in cooperation with the University of Tsukuba. Forty-four terminals are connected to a single microcomputer. The terminals, consisting of an ordinary home TV set and a keyboard, are placed in groups of four on circular tables. Figure Three outlines the overall system and Figure Four shows how the terminals are placed on the tables.

**FIGURE THREE**
**Takezono Higashi Elementary School's Microcomputer System**

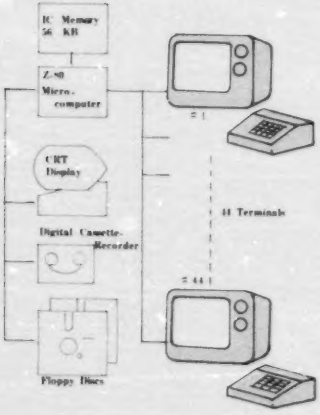
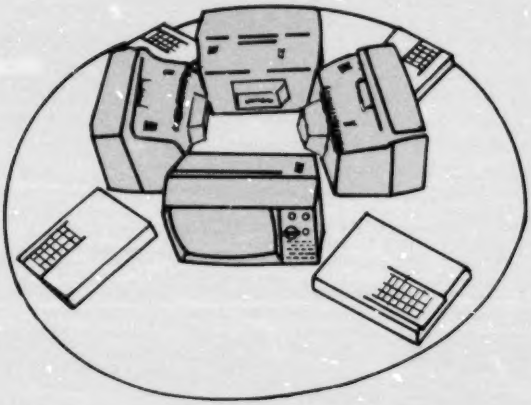


**FIGURE FOUR**
**Placement of Terminals on Each Table**



This system, used for classes in arithmetic, science and the Japanese language, aims at a "humanistic CAI." The workflow for the arithmetic lessons is 1) introduction, 2) basic study materials, 3) main drills, 4) remedial work routines, and 5) review and summary drills. The system is unusual in that a wide variety of messages can be displayed depending upon the student's responses. The students who have used this system have evaluated it as considerate of their needs and desires, enjoyable, interesting, and so on. The teachers have evaluated it as suitable for imparting a sound understanding of basic knowledge and skills, as able to match each student's learning pace, as good in that it gives each student feedback regarding his or her progress, and that it clearly shows the teacher how to give individual counseling and guidance.

(3) Chiba Municipal Hanamigawa Dai-ni Lower Secondary School (Chiba Prefecture)

The microcomputer club at the Hanamigawa Dai-ni Lower Secondary School currently has 39 members. This is higher than the average for the 33 different clubs formed at this school. The club now has 22 microcomputers of various types, including hand-held, pocket models. The goals of the club are "Learn how to use and how microcomputers are put together; Work together; Value friends; and, Learn how to develop one's own individuality." The students all learn how to use BASIC and display their own original programs during the Fall School Festival.

(4) Kosei Municipal Kosei Nishi Lower Secondary School (Shiga Prefecture)

This lower secondary school has developed a coordinated program for CMI microcomputer applications. Programs developed to date include four for instructional research, four for processing grades and test results, two for scholastic guidance, two for dividing the students into classes, and one for processing results of questionnaires. In doing this, the teachers in charge of each subject area worked together over a period of several years using the theme "Development of a system which will combine evaluation and guidance suitable to the abilities and personalities of every student." Emphasis was placed upon educational technology as a means for preparing instructional plans. The faculty of the Kyoto University of Education cooperated in the carrying out of much of the research done at this school.

(5) Tokyo Metropolitan Kohoku Upper Secondary School (Tokyo Prefecture)

This school purchased 50 microcomputers for student use plus two

for teacher use, a total of 52, in 1982, thereby making it number one among public upper secondary schools in Japan in regards to the number of microcomputers on hand. This equipment was procured under the Tokyo Metropolitan Board of Education's project of "Making evey school unique." What makes Kohoku Upper Secondary School even more unusual is that it does not have any vocational courses but is strictly a general academic school. None of the teachers had had any experience with microcomputers prior to the purchase of this system, but since then nearly all of them, regardless of what subject(s) they are teaching, have undergone at least some training. Today some of the teachers are able to use BASIC to prepare their own programs. The school's aim is to use microcomputers in general subjects. The first programs were developed for use in science (chemistry) classes. Currently, in addition to programs for mathematics classes and for learning BASIC, programs have been developed for individual study in chemistry and physics. The teachers are now working on programs for English, Classical Japanese and geography. Further, the system's word processor function has been used to prepare study materials and test questions for many of the courses.

(6) Tokyo Metropolitan Mukogaoka Upper Secondary School (Tokyo Prefectute)

This school's system consists of 50 terminals (individual learning machines) connected to a single microcomputer. The students use a cassette tape containing the study program, study cards and study notes with these terminals for self-paced study sessions. The terminals, consisting of a built-in microprocessor, a ten-key keypad, a liquid crystal display device and a cassette reader (for data storage and playback), control the study program and record the students' responses. The study cards contain the content to be learned as well as hints on how to study or

how to find the answers. This system is currently being used for instruction in physics and Classical Japanese.

(7) Towada Municipal Central Citizens' Public Hall (Aomori Prefecture)

As part of their social education activities, Towada City has started a series of "Microcomputer Classroom" lectures for the general public. The Central Citizens' Public Hall has procured ten microcomputers for these classes.

(8) Hisai Municipal Central Citizens' Public Hall (Mie Prefecture)

Hisai City rented nine microcomputers in order to be able to offer a public workshop on computers. They are using NHK's educational television series "Introduction Microcomputers" as part of the course.

(9) Hitachi Municipal Audiovisual Library (Ibaragi Prefecture)

In cooperation with the city's "Measures for Small and Medium Enterprises," the Municipal Audiovisual Library opened a "Hitachi Microcomputer Classroom" designed for people from local businesses and factories. A total of 18 microcomputers were leased for this purpose. There is an attendance fee for these lectures which are divided into "Introductory," "Beginning" and "Intermediate." Courses are offered during the day as well as during the evening. They have proven very popular and plans are now being made to offer courses for housewives, students, parent and child groups and teachers.

(10) Kanagawa Prefectural Youth Science Center (Kanagawa Prefecture)

This center has developed a science "quiz game" display for young

people which features a microcomputer as part of the display itself. Other displays on "Logic Circuits," "Guess the Contents of the Box," "Response Machine" and "People and Nourishment" also effectively incorporate microcomputer technology. A total of eight microcomputers are used in these various displays.

(11) Kyoto Municipal Youth Science Center (Kyoto Prefecture)

This center now has 41 microcomputers which are being used to offer CAI-type science courses to second year lower secondary school students who visit the center. The content is closely related to their school work. These microcomputers are also being used to process data from experimental research, to process Japanese-Chinese characters, graphs and so on, and to record data from a group response analyzer system. A third use is in combination with displays on "Atmospheric Pressures," "Test Your Ability at Mental Calculations" and "Let's Use a Computer."

(12) Toyohashi Municipal Audiovisual Education Center (Aichi Prefecture)

This Center is using two microcomputers to keep track of loans of audiovisual instructional materials (16mm films, 8mm films, slides, records, etc.), as well as for information retrieval, statistical processing and so on. The Center's equipment is also used for either title or keyword document search and to process data received from the surrounding schools on student physical development, grades and test results. Plans for upgrading the system by providing each school with a microcomputer and for establishing a data exchange and processing network within the Audiovisual Education Center are now being developed.

There are many other examples of microcomputer management and control of regional audiovisual education materials available but they cannot be described here due to space limitations. To name only two,

however, there is the Nagoya Municipal Audiovisual Education Center in Aichi Prefecture and the Sanjo Municipal Audiovisual Library in Niigata Prefecture.